CLAIMS

1. A process for preparing olefinic living polymers comprising polymerizing an olefinic monomer having 2 to 20 carbon atoms at a polymerization temperature of -20 to -100°C in the presence of a catalyst comprising:

(A-1) a hafnium-containing compound having one or two cyclopentadienyl backbones, and

(B) a borane compound (B-1) of the formula (I):

$$B(Ph)_3 \qquad (I)$$

wherein Ph is a phenyl group which may be substituted, or

a borate compound (B-2) of the formula (II):

$$B^-(Ph)_4X^+ \qquad (II)$$

wherein Ph is as defined above and X^+ is a cation, to produce a polymer having a molecular weight distribution (Mw/Mn) of 1 to 1.3.

2. A process for preparing olefinic living polymers comprising polymerizing an olefinic monomer having 2 to 20 carbon atoms at a polymerization temperature of -20 to -100°C in the presence of a catalyst comprising:

(A-1) a hafnium-containing compound having one or two cyclopentadienyl backbones,

(B) a borane compound (B-1) of the formula (I):

$$B(Ph)_3 \qquad (I)$$

wherein Ph is a phenyl group which may be substituted, or

a borate compound (B-2) of the formula (II):

$$B^-(Ph)_4X^+ \qquad (II)$$

wherein Ph is as defined above and X^+ is a cation, and

(C) an aluminum compound of the formula (III):

$$AlR_{3-n}Y_n \qquad (III)$$

wherein R is a hydrocarbon group having 4 to 20 carbon atoms, Y is a halogen atom, an alkoxyl group, a trialkylsiloxy group, a di(trialkylsilyl)amino group or a trialkylsilyl group, and n is 0, 1 or 2, to produce a polymer having a molecular weight distribution (Mw/Mn) of 1 to 1.3.

3. The process of Claim 1 or 2, wherein said polymerization temperature is from -30 to -80°C.

4. The process of Claim 1 or 2, wherein said polymerization temperature is from -40 to -80°C.

5. A process for preparing olefinic living polymers comprising polymerizing an olefinic monomer having 2 to 20 carbon atoms at a polymerization temperature of -60 to -100°C in the presence of a catalyst comprising:

(A-2) a zirconium-containing compound having one or two cyclopentadienyl backbones, and

(B) a borane compound (B-1) of the formula (I):

$$B(Ph)_3 \qquad (I)$$

wherein Ph is a phenyl group which may be substituted, or

a borate compound (B-2) of the formula (II):

$$B^-(Ph)_4X^+ \qquad (II)$$

wherein Ph is as defined above and X^+ is a cation, to produce a polymer

having a molecular weight distribution (Mw/Mn) of 1 to 1.3.

6. A process for preparing olefinic living polymers comprising polymerizing an olefinic monomer having 2 to 20 carbon atoms at a polymerization temperature of -60 to -100°C in the presence of a catalyst comprising:

(A-2) a zirconium-containing compound having one or two cyclopentadienyl backbones,

(B) a borane compound (B-1) of the formula (I):

$$B(Ph)_3 \qquad (I)$$

wherein Ph is a phenyl group which may be substituted, or

a borate compound (B-2) of the formula (II):

$$B^-(Ph)_4X^+ \qquad (II)$$

wherein Ph is as defined above and X^+ is a cation, and

(C) an aluminum compound of the formula (III):

$$AlR_{3-n}Y_n \qquad (III)$$

wherein R is a hydrocarbon group having 4 to 20 carbon atoms, Y is a halogen atom, an alkoxyl group, a trialkylsiloxy group, a di(trialkylsilyl)amino group or a trialkylsilyl group, and n is 0, 1 or 2, to produce a polymer having a molecular weight distribution (Mw/Mn) of 1 to 1.3.

7. The process of Claim 5 or 6, wherein said polymerization temperature is from -60 to -80°C.

8. A process for preparing olefinic living polymers comprising polymerizing an olefinic monomer having 2 to 20 carbon atoms at a

polymerization temperature of -20 to -100°C in the presence of a catalyst comprising:

(A-2) a zirconium-containing compound having one or two cyclopentadienyl backbones,

(B) a borane compound (B-1) of the formula (I):

$$B(Ph)_3 \qquad (I)$$

wherein Ph is a phenyl group which may be substituted, or

a borate compound (B-2) of the formula (II):

$$B^-(Ph)_4X^+ \qquad (II)$$

wherein Ph is as defined above and X^+ is a cation, and

(D) a titanium-containing compound.

9. A process for preparing olefinic living polymers comprising polymerizing an olefinic monomer having 2 to 20 carbon atoms at a polymerization temperature of -20 to -100°C in the presence of a catalyst comprising:

(A-2) a zirconium-containing compound having one or two cyclopentadienyl backbones,

(B) a borane compound (B-1) of the formula (I):

$$B(Ph)_3 \qquad (I)$$

wherein Ph is a phenyl group which may be substituted, or

a borate compound (B-2) of the formula (II):

$$B^-(Ph)_4X^+ \qquad (II)$$

wherein Ph is as defined above and X^+ is a cation,

(C) an aluminum compound of the formula (III):

$$AlR_{3-n}Y_n \qquad (III)$$

wherein R is a hydrocarbon group having 4 to 20 carbon atoms, Y is a

halogen atom, an alkoxyl group, a trialkylsiloxy group, a di(trialkylsilyl)amino group or a trialkylsilyl group, and n is 0, 1 or 2, and

(D) a titanium-containing compound.

10. The process of Claim 8 or 9, wherein said titanium-containing compound is a titanium-containing compound having one cyclopentadienyl backbone.

11. The process of Claim 8, 9 or 10, wherein at least one of said zirconium-containing compound having one or two cyclopentadienyl backbones (A-2) and said titanium-containing compound (D) contains an alkyl group.

12. The process of any of Claims 8 to 11, wherein said polymerization temperature is from -30 to -80°C.

13. The process of any of Claims 8 to 11, wherein said polymerization temperature is from -40 to -60°C.

14. The process of any of Claims 1 to 13, wherein Ph group in said formula (I) or (II) is a group substituted by 1 to 5 fluorine atoms.

15. The process of any of Claims 1 to 13, wherein Ph group in said formula (I) or (II) is a group substituted by five fluorine atoms.

16. The process of any of Claims 2 to 4, 6, 7 and 9 to 15, wherein n in said formula (III) is 0.

17. The process of any of Claims 2 to 4, 6, 7 and 9 to 15, wherein in said formula (III) n is 0 and R is an alkyl group having 4 to 8 carbon atoms.

18. The process of any of Claims 1 to 17, wherein said olefinic monomer is an α-olefin having 2 to 20 carbon atoms.

19. The process of any of Claims 1 to 17, wherein said olefinic monomer is an α-olefin having 2 to 10 carbon atoms.

20. The process of any of Claims 1 to 17, wherein said olefinic monomer is an α-olefin having 3 to 6 carbon atoms.

21. The process of any of Claims 1 to 20, wherein said polymerizing is carried out under the condition that the produced polymer is not precipitated.

22. The process of any of Claims 1 to 21, wherein said molecular weight distribution is from 1 to 1.2.